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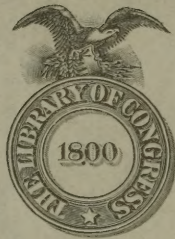
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A NEW METHOD OF GRADING

MILK AND CREAM.

By Wm.C.Woodward.



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UNITED STATES PUBLIC HEALTH SERVICE

A NEW METHOD OF GRADING MILK AND CREAM

BY

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A NEW METHOD OF GRADING MILK AND CREAM.¹

By WM. C. WOODWARD, Health Officer, District of Columbia.

That the score card has been of service in the improvement of sanitary conditions on dairy farms, possibly few will deny. It has failed, however, with respect to one most important feature of milk control inasmuch as it does not afford a sufficient basis upon which to found an opinion as to the wholesomeness and nutritive value of milk as it reaches the consumer. And if the scores of dairy farms give but an imperfect idea of the quality of the milk as it reaches the consumer, an attempted study of a series of scores of dairy farms and milk shops, chemical analyses and bacteriological analyses leaves the inquirer who is not technically skilled with respect to the matter in a dazed and quite helpless condition. In order to enable the consumer to determine the quality of the milk he is purchasing, the health department of the District of Columbia has devised a method for grading the finished product.

Essentials of the grading of milk.—Any ideal system of grading milk as delivered to the consumer must take into consideration the condition of all of the farms from which milk is or is liable to be derived, the condition of the milk shop from which it is distributed, the chemical analysis of the milk, and the bacteriological analysis. The result must be expressed in a manner easily understood by the public and in a way that will afford ready and fair comparison between milk from any number of sources.

Method of grading.—The method of grading milk adopted by the health department of the District of Columbia is as follows: 100 points are allowed for the dairy farm, both equipment and management; 100 points are allowed for the cattle; 100 points are allowed for the milk-distributing station, if the milk is not distributed directly from the farm; 100 points are allowed for the chemical analysis; and 200 points are allowed for the bacteriological examination. The total number of possible points is 600 if there be a milk-distributing station, and 500 if there be no such station. By dividing the total number of points allowed by the total number of points possible a figure is obtained in the form of a decimal fraction representing the grade of the milk. Any unusual conditions bearing upon the nutritive quality of the milk or on its wholesomeness, but not susceptible of being reduced to a

¹ Reprint from the Public Health Reports, Vol. XXVIII, No. 8, February 21, 1913.

percentage basis, are to be set forth in an explanatory note, if the grade is computed during the continuance of such conditions; such, for instance, as a milk-borne outbreak of typhoid fever or other contagious disease.

Rating the cattle.—For a number of years past the health department of the District of Columbia has scored health and cleanliness of cattle independently of the general score for management and equipment of the dairy farm, allowing 100 points for each. It has seemed to the department that under the method of scoring ordinarily adopted, enough weight is not allowed for the health of cattle nor enough latitude for variations in their healthfulness and cleanliness. But while the system of scoring cattle independently of farm management and equipment facilitates the scoring of milk in the manner herein described, yet with a simple mathematical adjustment the method can be used anywhere.

When the milk distributed through a given establishment comes from but one farm, the determination of the rating to be assigned to the cattle is a simple matter, requiring merely the finding of the average of the scores given the cattle at a series of inspections by the dairy-farm inspectors. But in every large milk-distributing establishment the milk comes from many farms, and these farms vary widely in the number and condition of the cattle maintained for dairy purposes. The milk distributed from such an establishment is a composite of the milk from all of the contributing farms. The influence of each farm on the composite mixture, however, is not equal, but depends upon the proportion and quality of the milk it contributes as compared with the whole output. For practical purposes the proportion of milk supplied may be regarded as determined by the number of cows maintained. The method adopted, therefore, allows weight to the score for each dairy herd proportionate to the number of cattle it contains. The score for the herd on each farm is multiplied by the number of cattle in it. The total number of cattle in all contributing herds is learned by reference to the dairy-farm records. Then all of the scores, multiplied as above described, are added, and the sum thus obtained is divided by the total number of cattle. The quotient is the rating for the cattle.

The method may best be understood by a simple illustration. Producers A, B, and C all send their milk to Dairy No. 342. A has 100 cows, scored 100. B has 50 cows, scored 80. C has 10 cows, scored 40. To determine the rating to be allowed for the cattle in computing the final score:

Producer.

A.....	(number of cattle) 100 (multiplied by score) 100=10,000
B.....	(number of cattle) 50 (multiplied by score) 80= 4,000
C.....	(number of cattle) 10 (multiplied by score) 40= 400

160

14,400

Dividing the sum of the multiplied score, 14,400, by the total number of cattle, 160, the quotient is 90, the rating to be allowed for the cattle in determining the grade of milk distributed by the common distributing agency, Dairy No. 342.

The significance of the method is best understood by supposing that the 100 cows on the farm of A were scored 40 instead of 100 and the 10 cows on the farm of C were scored 100 instead of 40, the score for B's herd remaining the same. The resulting rating would then be as follows, notwithstanding the fact that the milk would still come from exactly the same number of cows, on the same farms, with the same ratings, viz, 40, 80, and 100.

Producer.

A.....	(number of cattle) 100	(multiplied by score) 40=4,000
B.....	(number of cattle) 50	(multiplied by score) 80=4,000
C.....	(number of cattle) 10	(multiplied by score) 100=1,000
	<hr/> 160	<hr/> 9,000

Dividing the sum of the multiplied scores, 9,000, by the total number of cattle, 160, the quotient is 56.25, the rating for the cattle in determining the grade of the composite milk output.

If the simple method of averaging the scores of all herds without reference to the number of cattle in each had been adopted, the rating would have been the same in each instance: (Score 100, plus score 80, plus score 40) divided by the number of herds, 3, equals 73.33.

The method of rating the cattle has been described at some length and enlarged upon by illustrations in order that it may be made perfectly clear. The elaboration may possibly have served to convey the impression that the method is complicated, but a few minutes' study of it will show that such is not the case. The application of the method to any considerable number of dairy-herd ratings will, however, certainly be tedious unless the records have been kept especially for the purpose of facilitating such computations. This department has devised a system of record keeping, illustrated in the table on page —, that is expected to facilitate the making of such computations in the future. In the meantime, in determining the rating of the cattle furnishing milk to any particular distributing establishment, the department will not undertake to consider the score for every dairy farm but only for a number representing a fair average, say five, selected at random.

If on any farm a substantially new herd is obtained, as when a herd is tuberculin-tested and all "reactors" are eliminated from it, the rating for dairy cattle is based solely on scores for the new or renovated herd.

Rating of the dairy farm.—What has been said with reference to the determination of the rating to be assigned to the cattle applies with equal force to the determination of the rating for the equipment

and management of the dairy farm. Due weight must be allowed for the amount of milk that each farm supplies, and this can be done in the same way as weight is allowed for the score for health and cleanliness of cattle, pointed out in the preceding paragraphs.

Rating of dairies.—The term "dairy" in the District of Columbia is regarded as meaning merely the place from which the milk is distributed within the city. As every establishment is scored on the basis of 100, it is necessary merely to take a number of scores of the dairy under consideration sufficient to be fairly representative, say three, and to find the average.

Rating of chemical analyses.—The value of the chemical analysis of milk lies in the fact that it shows the food value. Cases of deliberate watering are in this jurisdiction rare, and the use of preservatives and coloring matter is practically unknown. In order that the results of chemical analyses may be used in the grading of the milk, it is necessary to reduce them to a scale, with 100 as a maximum. As the nutritive value of milk is determined by the total solids, the scale adopted by the health department is based upon the percentage of total solids and not upon the fat. The scale is as follows:

Scheme for rating chemical analyses.

Total solids:	Rating.
11 per cent or less.....	0
More than 11 per cent but not more than 12 per cent.....	40
More than 12 per cent but not more than 12.50 per cent.....	60
More than 12.50 per cent but not more than 12.75 per cent.....	70
More than 12.75 per cent but not more than 13 per cent.....	80
More than 13 per cent but not more than 13.25 per cent.....	90
More than 13.25 per cent.....	100

If any sample contains added water, deduct 40 points. For milk containing preservatives of any sort deduct the entire chemical rating, and give zero for the bacteriological rating immediately preceding the finding of the preservatives. The average rating of not less than three consecutive analyses is to be taken.

Rating of bacteriological analysis.—In determining the grade of the milk as sold, 200 points are allowed for bacteriological analysis. As some bacteria are found in all milk in the ordinary channels of trade and may, therefore, be looked upon as commercially normal, the primary rating takes into consideration merely the total bacterial count. Bacilli of the colon group and streptococci are, however, looked upon as foreign to wholesome milk, and for their presence certain deductions are made from the rating allowed on the basis of the total bacterial count alone. The remainder represents the absolute rating for the bacteriological examination of the milk. The standards adopted are as follows:

Rating for bacteriological findings.

Raw milk.	Pasteurized milk.	Points allowed.
5,000,000 and upward.....	100,000 and upward.....	0
4,000,000 to 5,000,000.....	90,000 to 100,000.....	20
3,000,000 to 4,000,000.....	80,000 to 90,000.....	40
2,000,000 to 3,000,000.....	70,000 to 80,000.....	60
1,000,000 to 2,000,000.....	60,000 to 70,000.....	80
500,000 to 1,000,000.....	50,000 to 60,000.....	100
400,000 to 500,000.....	40,000 to 50,000.....	120
300,000 to 400,000.....	35,000 to 40,000.....	140
200,000 to 300,000.....	30,000 to 35,000.....	160
100,000 to 200,000.....	25,000 to 30,000.....	170
50,000 to 100,000.....	20,000 to 25,000.....	180
25,000 to 50,000.....	15,000 to 20,000.....	190
10,000 to 25,000.....	10,000 to 15,000.....	195
Less than 10,000.....	Less than 10,000.....	200
For the first 1,000 colonies of the colon group or streptococci, whichever may be the more numerous, deduct 20 points and deduct 10 points for each subsequent 1,000.		For the first 100 colonies of the colon group or streptococci, whichever may be the more numerous, deduct 10 points, and deduct 2 points for each subsequent 100.

It will be noted that the foregoing plan for the evaluation of the bacteriological findings lays down a basis for raw milk different from that for pasteurized milk. This is undoubtedly fair when the ratings of two or more samples of milk of the same class are to be compared, but it would be manifestly unjust to compare such a rating of raw milk with a rating of pasteurized milk unless this difference were taken into consideration. In order to prevent such unfair comparisons, ratings for pasteurized milk should be accompanied always by some descriptive term, say the word "pasteurized," and if it be desired to compare the ratings of pasteurized milk with a rating of raw milk, both should be scored on the same basis, preferably that for raw milk.

Hypothetical cases may easily be conceived in which the scales laid down above would give figures manifestly misleading, and possibly such cases may be found in practice. Such would be a case in which the colonies of the colon group or the streptococci were numerous while the general bacterial count was very low. A fair examination of a reasonable number of entries in the records of this department, however, failed to reveal any instances of this kind.

In any case the average rating of not less than three consecutive analyses is to be taken.

Examples.—As an illustration of the way in which the method of scoring described above works out in practice, the following examples are given from the records of this department:

Health Department of the District of Columbia—Dairy record.

DAIRY NO. 1. LICENSEE: JOHN DOE. RAW MILK.

Date.	Dairy farm.				Dairy score.	Chemical analysis.		Bacteriological analysis.				Remarks.
	Farm No.	No. cattle.	Cattle score.	Farm score.		Total solids.	Rating.	Total count.	Colon.	Streptococci.	Rating.	
1912.												
Apr. 27.....						13.32	100					
May 29.....	934	200	100	99.3								
Oct. 9.....					86.61							
Nov. 7.....					84.68							
Nov. 25.....								2,100	0	0	200	
Dec. 7.....	934	160	100	98.0				5,000	0	0	200	
Dec. 21.....												
1913.												
Jan. 10.....	934	150	100	98.5								
Jan. 11.....					86.21							
Jan. 14.....						13.54	100					
Jan. 14.....						13.32	100					
Jan. 31.....								2,800	0	0	200	
Ratings for milk Feb. 10.....			100	98.6	85.2		100				200	

Grade for output of Dairy No. 1, John Doe, proprietor, 97.3.

NOTE.—This is the grading for a special milk, sold for more than twice as much as ordinary market milk.

DAIRY NO. 2. LICENSEE: RICHARD ROE. PASTEURIZED MILK.

1912.												
July 11.....	1327	63	70	68.2								
Sept. 19.....	1764	40	100	84								
Oct. 11.....					99.85							
Nov. 12.....					99.63							
Nov. 12.....						13.32	100					
Nov. 13.....						13.08	90					
Dec. 4.....	4945	15	70	68.0								
Dec. 24.....	383	21	67	60.5								
1913.												
Jan. 3.....								21,000	200	100	168	
Jan. 14.....								5,000	0	0	200	
Jan. 15.....					99.78							
Jan. 19.....								3,000	0	0	200	
Jan. 24.....	763	29	66	41.7								
Jan. 30.....						13.17	90					
Ratings for milk Feb. 10.....			75.4	66.4	99.7		93.3				189.3	

Grade for pasteurized milk sold by Dairy No. 2, Richard Roe, proprietor, 85.

Rating of cream.—While no chemical or bacteriological standards have been laid down for cream and other milk products, the method of grading described above may readily be applied to them, proper scales being first established for chemical and bacteriological data.

Conclusions.—The method of determining the nutritive value of milk and its wholesomeness and of expressing them in a single figure, as described in this article, is not perfect or final; it will be improved

as the result of the future experience of the writer and of others. It is believed, however, to mark an advance in the supervision and control of the milk supply in that it enables the supervising officer to give to any consumer definite and easily understandable information as to the relative nutritive value and wholesomeness of milk from different sources in the very form in which the milk from each may be expected to reach the consumer. The method is applicable to any grade of milk, from certified milk to "cooking" milk, and prices may be fixed according to the grade of the milk furnished, without any formal "certification" as the term is now understood, and without any official "classification."

As the method of scoring herein proposed becomes familiar to the consuming public, of all milk selling at a given price that milk will be most in demand which has the highest rating, and if circumstances make it expedient to increase the price of milk, a dealer, if his milk has a high grade, can logically refer to that fact in justification of the increase. To every dealer who desires to increase his business and to every dealer who wants to raise his price—and this would seem to include all dealers whatsoever—a high grading of his output becomes of commercial value. Clearly, however, in order to obtain a high grading for his milk as he delivers it to the consumer the dealer will not only have to see that the milk is carefully handled after it comes into his possession, but will have to obtain it in the first instance from farms that score high. The dealer, therefore, will have to keep in closer touch than heretofore with farms that produce milk for him. A good farm score becomes then also of commercial value, since such a score sustains the grade of the milk as delivered, while a low farm score pulls it down; and it becomes of more interest to the farmer than it now is to conduct his farm in such a manner as to obtain the highest score possible.

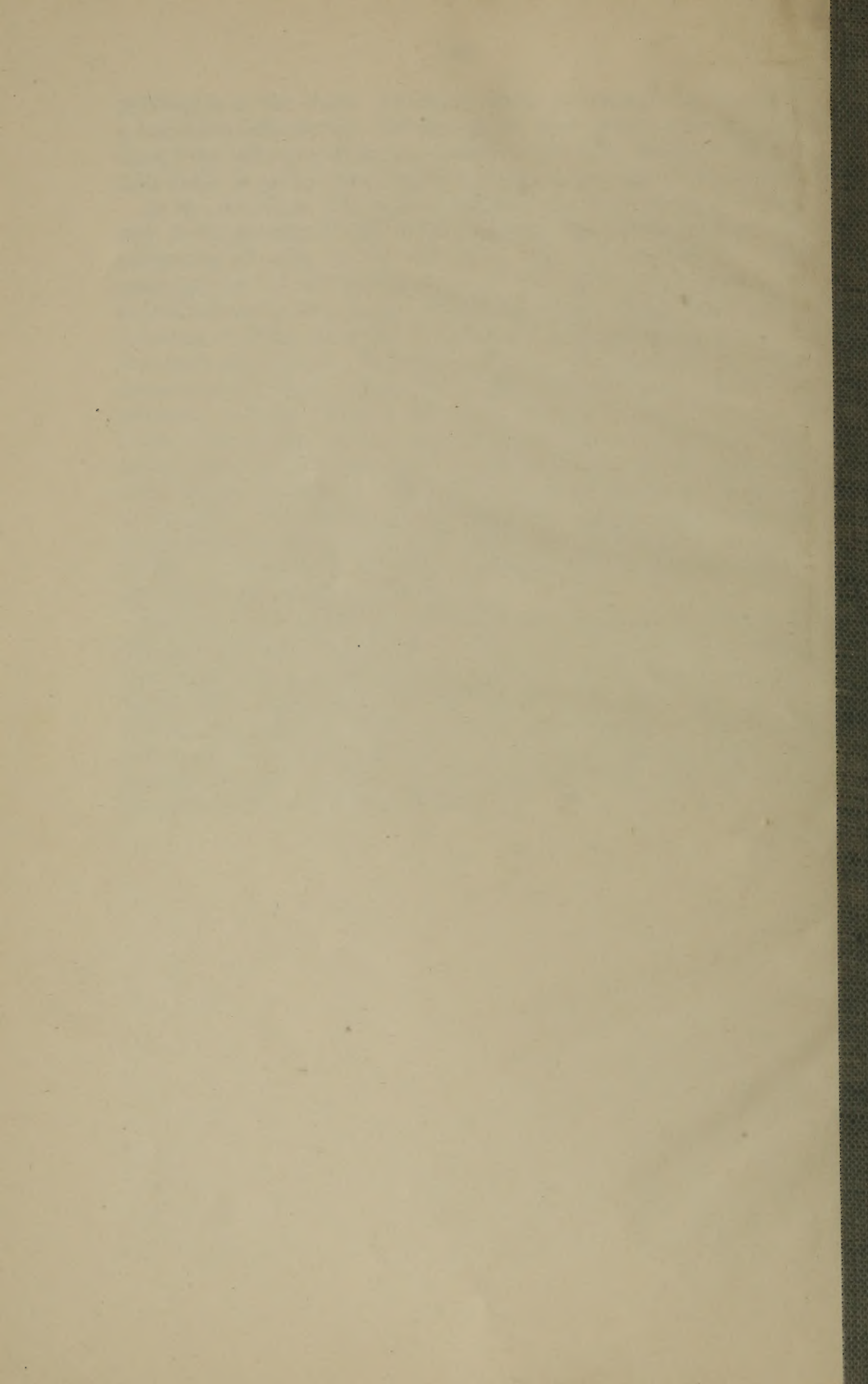
The method of grading milk herein proposed reduces to a minimum the influence of the personal equation. The scoring of a single farm by the same dairy farm inspector at different times or, as will most commonly be the case, the scoring of different farms by different inspectors at different times, and the scoring of the dairy or milk shop at still different times and by other inspectors, will reduce the personal equation very much; and with respect to all, except possibly the very last score, that will be taken into consideration when any given milk grade is computed, the interested farmer or milk dealer will have opportunity to appeal from the inspector to the higher supervising officer before the score enters into the grading. Chemical analyses will, moreover, presumably be made by one person and bacteriological examinations by another, and as three or more of each of these will enter into the final grading, it may be possible even that two or more chemists and two or more bacteriologists will

participate in the work. Certainly, then, personality can have but a minimum influence in determining the final grade—that is, if we except the influence of the personality of the milk producer and the milk dealer in each conducting his business as it should be conducted.

As the records of the department have not been arranged with a view to the grading of milk in the manner proposed in this article, the computing of milk grades will for a time be troublesome. The rearrangement of the system of record keeping in such a manner as to facilitate in the future the computation of milk grades will involve, however, no great difficulty. A tentative arrangement is shown in the specimen gradings which appear on page 338, figures from actual records having been transferred to the form of record which it is proposed to keep. Figures are to be entered on such a proposed record daily as they come in from the inspectors and from the laboratories, but it will be necessary to compute ratings for the milk only when request is made, or otherwise at stated intervals, say monthly, or quarterly. The results of such periodical computations should be communicated to the milk dealer primarily interested, for his information and guidance, and such a course will be followed if clerical assistance be available for that purpose.

While the grading of milk in the manner described in this article will consume some time and, therefore, add to the cost of the milk inspection service, it will make of practical value many reports and figures now collected at a considerable cost, and then buried in the official records without affording a basis for intelligent action by the milk supervising authority or, what is even more important, for intelligent action by the consuming public, which, after all, is in supreme control of the milk situation.





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